The Prevention and Identification of Math Disability Using RTI

This Presentation

Part 1: First Grade
(comprehensive math curriculum)

Part 2: Third Grade
(math problem solving)

1

Part 1: Math RTI at First Grade

Lynn Fuchs, Don Compton, Doug Fuchs,
Kim Paulsen, Joan Bryant, and Carol Hamlett
Vanderbilt University

Journal of Educational Psychology, 2005

Funded by OSEP Grant #H324U010004
National Research Center on Learning Disabilities

2

RTI in Math: What Do We Know?

A lot is known about preventing reading disability, especially on word-level skill at first grade.

Much less is known about preventing math disability.

No validated tutoring interventions at first grade.

The small body of work on math RTI at first grade:

- Basic facts or simple computation
- Using brief, drill/practice intervention
- In few classrooms (unrepresentative of range of instructional quality)

Even less work has been done on the identification part of RTI.

3

Our First-Grade Study

- Addressed other curricular components of math
- Incorporated sustained intervention
- Employed random assignment to explore efficacy of intervention to which responsiveness is gauged
- Included more classrooms to represent instruction of varying quality
- Addressed prevention and identification

4

First-Grade Study Purposes

- Purpose 1: Examine the efficacy of preventative tutoring in math at first grade
- Purpose 2: Assess the prevalence and severity of MD, with and without preventative tutoring and as a function of identification method
- Purpose 3: Explore the pretreatment cognitive abilities associated with math development in first grade

This presentation focuses only on purposes 1 and 2.

5

Sample

- 41 1st-grade teachers in 6 Title 1 and 4 non-Title 1 schools (92% consented students)
- Conducted weekly CBM Computation
- Using Week 4 CBM Computation, identified the 139 lowest performing students (21% of 667 consented students) as AR; randomly assigned these AR to control or tutoring
- NAR: 528 remaining students with consent
- Of 528 NAR:
  - All weekly CBM Computation
  - 180 sampled for individual and group pre/posttesting
  - 348 group pre/posttested
- With attrition, samples sizes of:
  - 127 AR: 63 control + 64 tutored
  - 437 NAR: 145 individually/group tested + 292 group tested

6

Pretreatment Scores
NAR > AR Control, AR Tutored

	NAR		AR Control		AR Tutored	
WASI	92.50	(9.31)	85.40	(8.70)	85.44	(8.48)
WID	110.28	(7.95)	103.46	(11.88)	101.19	(11.95)
WA	106.74	(13.48)	98.44	(16.20)	97.28	(14.26)
+ Facts[a]	103.15	(15.35)	89.67	(6.70)	89.07	(5.97)
-Facts[a]	102.10	(16.31)	92.41	(4.23)	92.91	(5.07)
WJ-Calc	108.82	(11.68)	96.56	(12.71)	97.59	(13.82)
CBM Comp[a]	104.31	(14.49)	85.26	(5.26)	85.31	(6.09)
WJ-AP	102.90	(11.90)	93.71	(9.82)	93.13	(9.55)
Gr 1 Conc/App[a]	104.37	(13.59)	86.41	(8.68)	84.97	(9.03)
Story Problems[a]	102.94	(15.30)	90.70	(8.30)	89.67	(8.26)

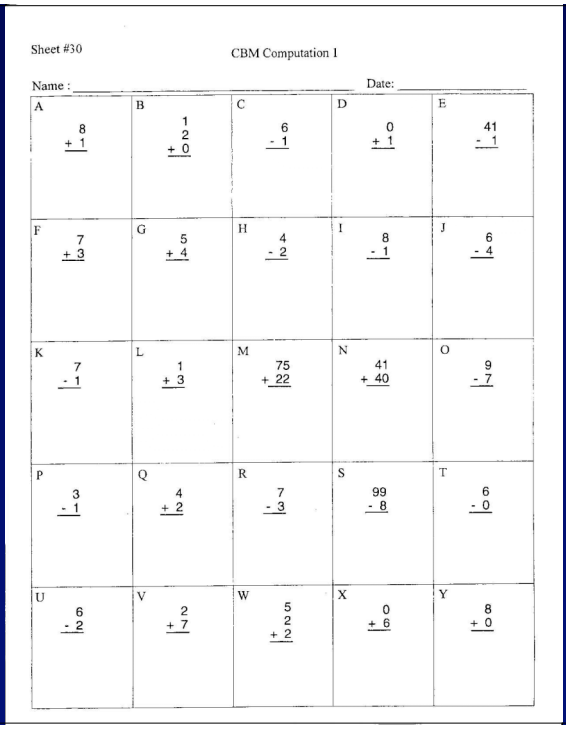
[a] Standard scores in relation to sample

7

Study Measures (Math)

- **Pre/Post/FU**
  - + Facts; - Facts
  - First-Grade Computation
  - First-Grade Concepts and Applications
  - Story Problems
  - WJ Applied Problems
  - WJ Calculation
- **CBM for Progress Monitoring** (Administered Weekly in Classrooms by Teachers)

8



Sheet #30

CBM Computation 1

Name : _____ Date: _____

A 8 + 1	B 12 + 0	C 6 - 1	D 0 + 1	E 41 - 1
F 7 + 3	G 5 + 4	H 4 - 2	I 8 - 1	J 6 - 4
K 7 - 1	L 1 + 3	M 75 + 22	N 41 + 40	O 9 - 7
P 3 - 1	Q 4 + 2	R 7 - 3	S 99 - 8	T 6 - 0
U 6 - 2	V 2 + 7	W 52 + 2	X 0 + 6	Y 8 + 0

9

Tutoring

Small groups (11 groups of two students and 16 groups of three students)

3 times per week outside classrooms

Each session:

- 30 min of teacher-led instruction
- 10 min of student use of software, Math Flash (designed to improve automatic retrieval of math facts)

10

Teacher-Led Instruction

- Concrete-representational-abstract model, which relies on concrete objects to promote conceptual understanding (e.g., base-10 blocks for place value instruction)
- 17 scripted topics addressing number concepts, numeration, computation, story problems (e.g., not geometry, measurement, charts/figures, money)
- Clear rules for mastery of topics
- Cumulative review as each new topic is introduced

11

Math Flash

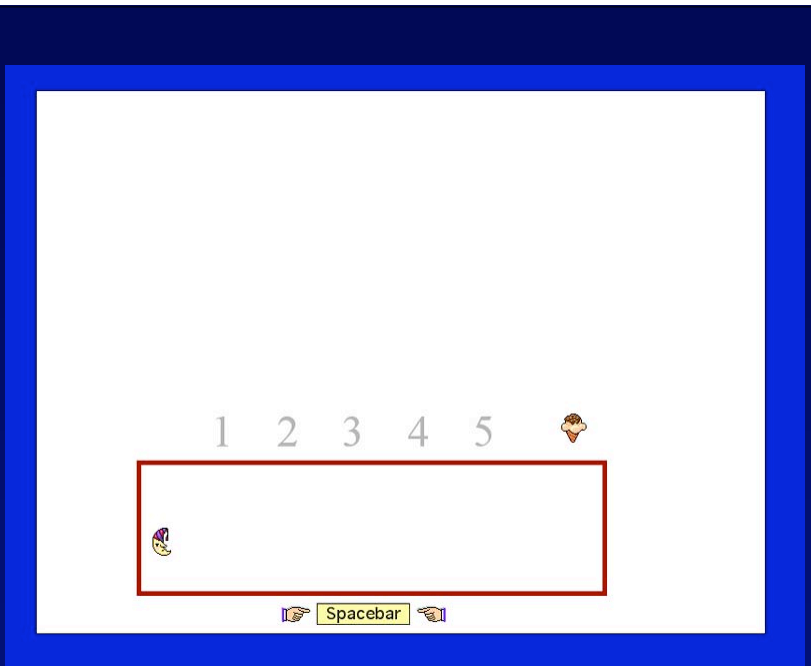
- Math fact flashes on and disappears from computer screen.
- Student types fact from short-term memory.
- If correct, computer applauds, says the fact, and awards a point (5 points = a "trinket" for the toy box at the bottom of the screen).
- If incorrect, computer removes incorrect fact, replaces it with correct fact, and says the fact.
- At end of each session, feedback is provided about number of correct and highest math fact mastered.

12

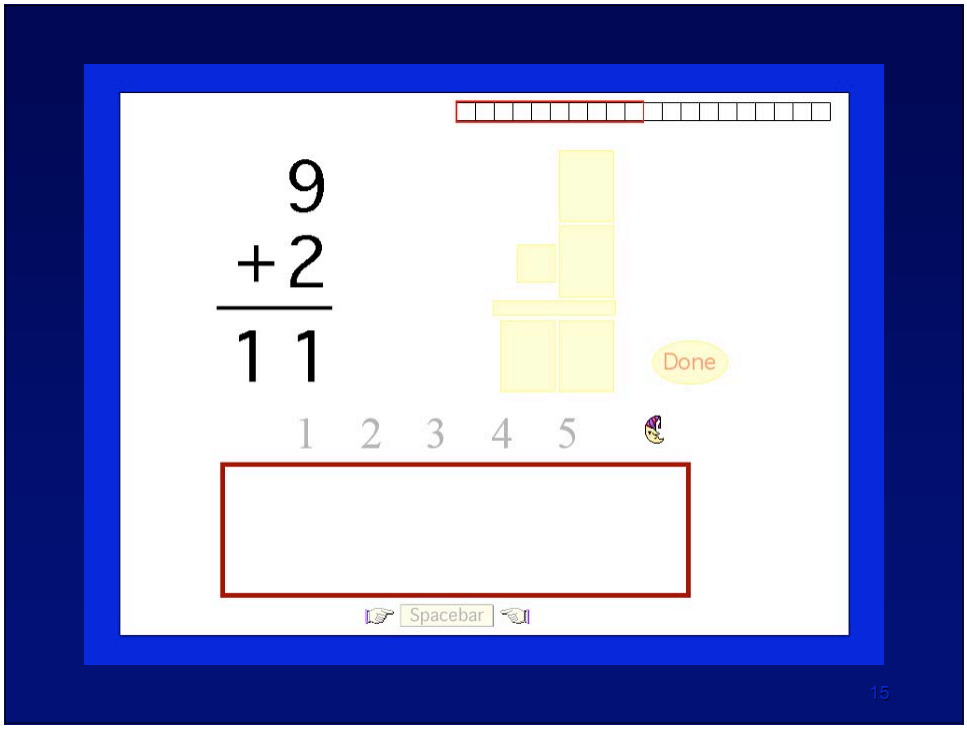
Math Flash

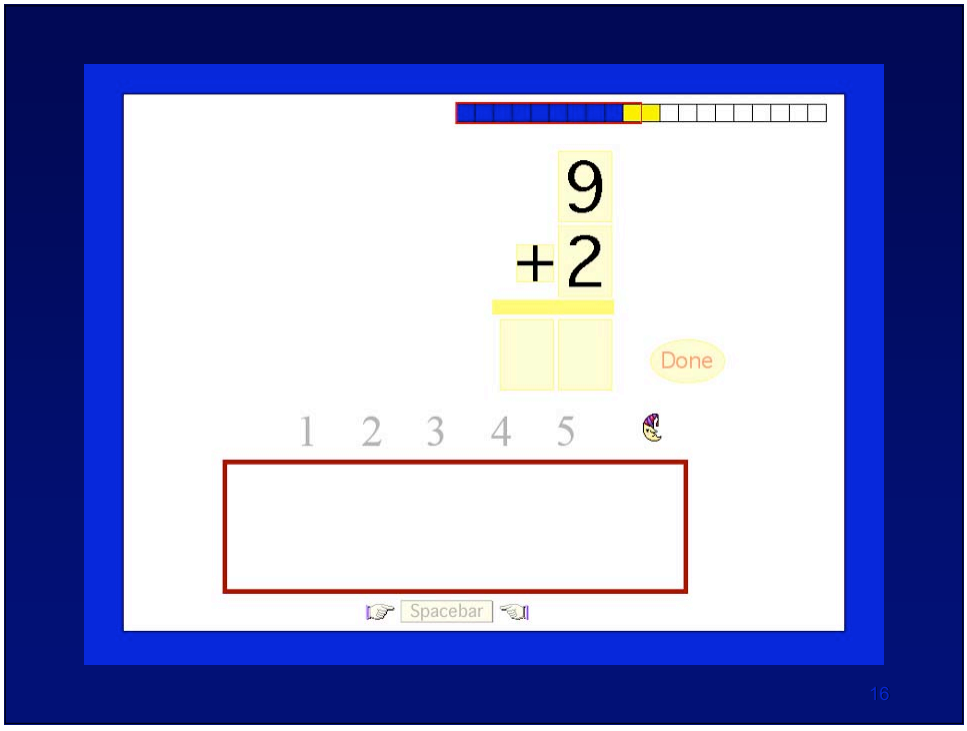
- Design reflects assumption that active and repeated pairing of problem stem with correct answer in short-term memory establishes the association in long-term memory.
- Facts are organized in conceptually-related sets and families.
- Once response to a math fact is consistently correct, it is moved to a "mastered" set.
- Cumulative review on mastered facts is provided (if student responds incorrectly, it is moved out of the mastered set).

13



14


9
+2
11
Done
1 2 3 4 5
Spacebar
15


9
+2
Done
1 2 3 4 5
Spacebar
16

Purpose 1: Tutoring Efficacy

Improvement

- *Weekly CBM Computation Slope*
  - AR tutored = NAR > AR control
- *WJ III Calculation*
  - AR tutored > NAR and AR
- *Grade 1 Concepts/Applications*
  - AR tutored > NAR and AR control
- *Story Problems*
  - NAR > AR tutored > AR control

➢ **First-grade tutoring enhances outcomes.**

17

Purpose 1: Tutoring Efficacy

Did tutoring decrease MD prevalence?
Yes, across identification options,
tutoring substantially decreased prevalence.

e.g., Final Low Achievement (<10th percentile)
on Grade 1 Concepts/Applications, prevalence went from 9.75% without tutoring to 5.14% with tutoring.
~ 2.5 million fewer children identified MD

One year later, at end of grade 2, AR tutored students remained significantly less likely to qualify as MD (compared to AR control students).

18

Purpose 2: MD Classification

MD Prevalence and Severity Changes as a Function of

~ IQ-Achievement Discrepancy vs. RTI

~ Alternative Ways of Operationalizing RTI
(i.e., defining "nonresponse" to Tier 2 tutoring)

Two Promising RTI Definitions of Nonresponse
(1) Final Low Achievement (<10th percentile)
on Grade 1 Concepts/Applications
(2) Low CBM Computation Slope with Low CBM Computation Final Score
(< 16th percentile)

19

In Sum, First-Grade Study Results …

- Demonstrate efficacy of 1st-grade tutoring.
- Indicate that RTI can reduce MD prevalence.
- Illustrate how options for designating MD affect prevalence and severity.
- Provide insight into which RTI methods for designating nonresponse to Tier 2 tutoring may function with integrity for identifying MD

20

What About Math RTI At Other Grade Levels?

Extending RTI to
Math Problem Solving at Third Grade

Funded by OSEP Grant #H324C030115

21

Our Work on Math Problem Solving at Third Grade

- How to use a validated math problem-solving intervention, known as "Hot Math," within a multi-tiered RTI system
- Tier 1: General Education Hot Math
- Tier 2: Small-Group Tutoring Hot Math

22

Hot Math

- At Tier 1,
  - First unit on general math problem-solving strategies (control group also received this)
  - Then, 4 additional Hot Math units, each dedicated to one problem type
    - Explicit instruction on skill acquisition
    - Explicit instruction on how to transfer: Teach students how to recognize novel problems as belonging to a problem type for which they know a solution method
    - Self-regulation strategies
- At Tier 2, instruction is more intense, focuses on difficult concepts within Hot Math, and employs a systematic reinforcement system to encourage on-task behavior and hard work.

23

RTI: Math Problem Solving at Third Grade

- Across 2 years, worked in 13 schools.
- At Tier 1, randomly assigned (within schools) 40 classrooms to Hot Math and another 20 to control (conventional classroom instruction).
- Tier 1 Hot Math sessions occurred 2-3 times per week for 16 weeks, with 25-40 minutes per session.
- For Tier 2: Identified AR students and (within classes) randomly assigned then to Hot Math tutoring or control.
- Tier 2 tutoring occurred 3 times per week for 13 weeks, 30 minutes per session.

24

Results to Date

- Estimated the effects of each tier of Hot Math intervention separately and in combination:
  - Four conditions
    - No Hot Math at either tier
    - Hot Math only at Tier 1
    - Hot math only at Tier 2
    - Hot Math at Tiers 1 and 2
- Designated lack of responsiveness as scoring more than 1 standard deviation below the growth of the 600 students in the Hot Math classrooms.

25

Rates of Unresponsiveness

• No Hot Math	86% - 100%
• Hot Math only at Tier 1	29% - 54%
• Hot math only at Tier 2	55% - 62%
• Hot Math at Tiers 1 and 2	12% - 26%

- So, RTI that incorporates 2 tiers of validated intervention may represent a promising structure for preventing and identifying MD in problem solving at third grade.

26

Materials

- First-Grade Tier 2 Tutoring Manual
- Tier 1 Hot Math Manual
- Tier 2 Hot Math Manual

27

Contact

Flora Murray
flora.murray@vanderbilt.edu
Vanderbilt University
328 Peabody College
Department of Special Education
Nashville, TN 37203
(615) 343-4782

28